EXPLOSIVES IN WATER RESOURCES

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This report was prepared by personnel from the Miles City, Montana, District of the Bureau of Land Management, and is shared as a tool in the management of grazing land in the western United States. It was prepared by:

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A fast, efficient means of obtaining water sources, either by renewing silted-in reservoirs or placing new pits in selected drainages, can be done by using explosives, Figure 1. During the past year, the Miles City, Montana, District of the Bureau of Land Management (BLM) has blasted about 40 pits on several allotments in a program which has promise as a future management tool.

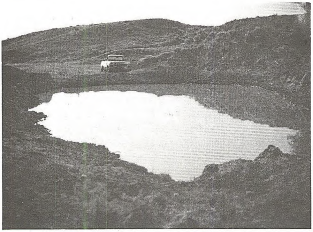


Figure 1. A typical pit that has been blasted for a water source for animals.

Initially the program was to rehabilitate existing silted-in reservoirs and to disperse livestock grazing pressure. The success of these pits has led to establishing new water sources, achieving better distribution of livestock grazing on native range and providing more water for wildlife, Figure 2. On many allotments, livestock use is inflexible due to location of available water. Consequently the same areas are utilized each year during the critical spring growth period.

Figure 2. Another tyical pit blasted from a relatively level, grassy area.

Water from these pits provides for more flexible use and deferment of grazing in areas affected by condition or drought. Such a means of controlling livestock with water is less expensive than fencing. Location of these pits in areas of suitable, but nonused, range due to a lack of water would reduce use on heavily grazed areas by up to 35 percent. This could be illustrated as follows. A 10-section pasture (6,400 acres) rated at 5 acres per AUM provides 1,280 AUMs. If stocked with 300 cattle and with 10 strategically placed pits (30 animals per pit for 1½ months at 7.5 acres per AUM) would provide a total of 3,375 acres of under-utilized range producing 450 AUMs. This under-utilized 450 AUMs is 35 percent of the available 1,280 AUMs.

The best sized pit is 80 feet long by 55 feet wide by 10 feet deep. This results in a bowl shaped pit with rounded sides and 3 to 1 end slopes which allow access, Figure 3. This is a storage capacity of about 0.56 acre foot or about 182,500 gallons (estimated). A cow needs about 20 gallons per day. A herd of about 30 cows could expect to have about 151 days of water when a pit is filled. The remainder would be used by wildlife, or lost due to evaporation, turbidity or access problems. The blasted pits, by reducing the water surface subject to evaporation, can maintain their water content over a longer period of time than traditionally constructed reservoirs.

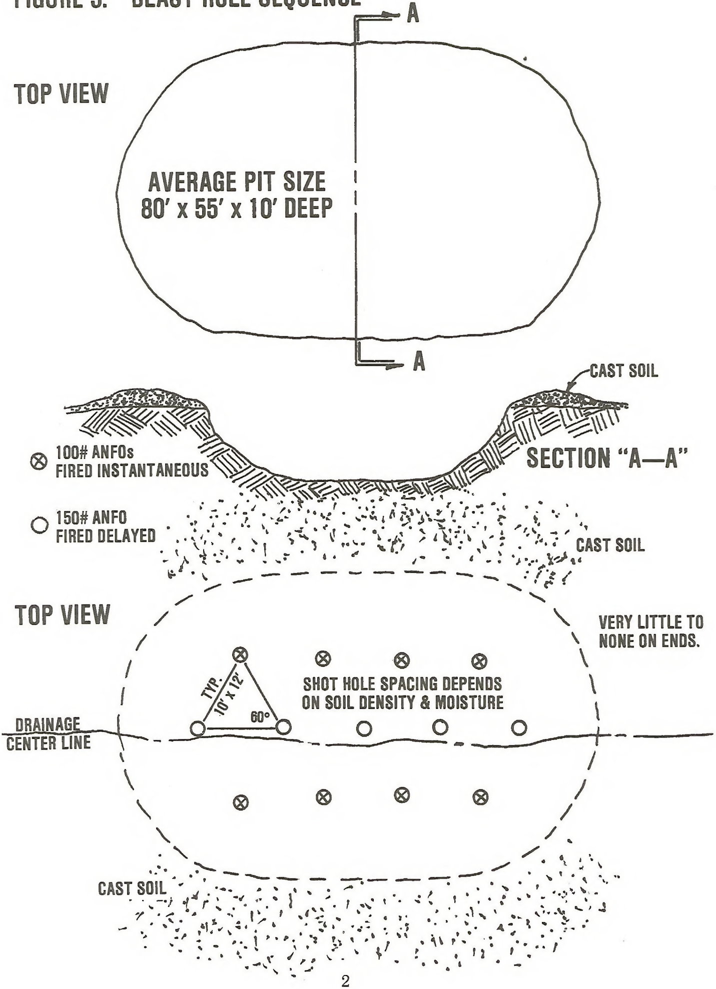
On many allotments, livestock use is inflexible due to available water. Consequently, the same areas are utilized each year during the critical spring growth period. By providing water through the use of blasted pits, an opportunity is provided for more flexible use and areas can be deferred that presently are in down or declining condition.

The year during which the program was initiated, 1984, was not a good year to fully evaluate its effectiveness, as there was only one rain (about June 1) that had any appreciable runoff.

A check made of the 35 pits blasted in February of 1984 on the Hook Ranch was made in August of 1984. Some pits were dry, due to lack of runoff, but about half had received some runoff and were being utilized. In some cases, they were the only water source in the pasture and increased the length of time cattle could stay in a pasture by 3 weeks to a month.

The ranch manager felt some pits had not held water, but would seal up after a runoff or two. He said they were planning to use their D-4 caterpillar to clear the berm away from the upstream side of several pits and to construct trail dikes as

FIGURE 3: BLAST HOLE SEQUENCE


A
TOP VIEW
AVERAGE PIT SIZE
80′ x 55′ x 10′ DEEP
A
CAST SOIL
⊗ 100# ANFOs FIRED INSTANTANEOUS
SECTION "A—A"
○ 150# ANFO FIRED DELAYED
CAST SOIL
TOP VIEW
VERY LITTLE TO NONE ON ENDS.
TYP. 10′ x 12′
60°
SHOT HOLE SPACING DEPENDS ON SOIL DENSITY & MOISTURE
DRAINAGE CENTER LINE
CAST SOIL

NARROW DRAINAGE SITE

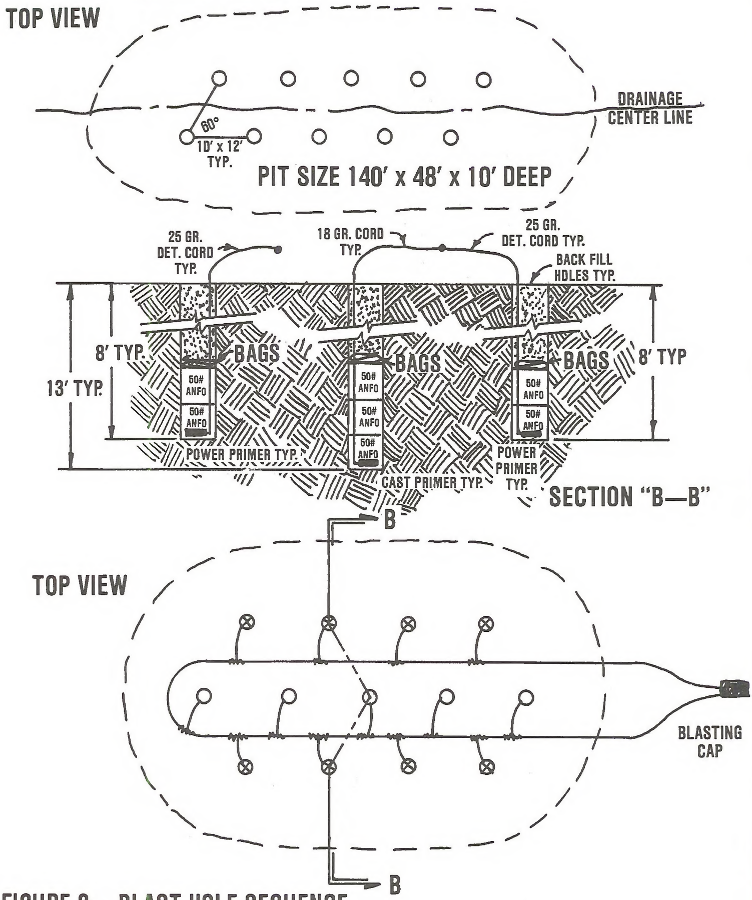


FIGURE 3: BLAST HOLE SEQUENCE (Continued)

needed. They had had no problem with cattle bogging in the pits, which can often occur with more traditional types of watering reservoirs.

Another rancher was pleased with the pits blasted near his ranch and requested more to see if erosion due to heavy runoff on L-S Creek (Garfield County) could be retarded or reduced.

Other Uses

The pits lend themselves to a number of applications, in addition to providing a water source for livestock, they also provide a water source for wildlife, can be used to disperse livestock within various areas of a pasture or grazing land and can also be used to increase conception rates by controlling the number of stock using a particular area. Another possible use is to isolate an island for wildlife use by blasting away part of a peninsula. See Figure 4.

Such a means of controlling grazing with water is much less expensive than fencing and can also be used to control overuse of an area.

With their ease of placement, the pits may be used as a silt trap when placed in a drainage above a reservoir that may be subject to excess siltation. Such a use could increase the life expectancy of a reservoir.

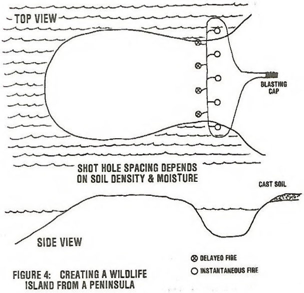

TOP VIEW
BLASTING CAP
SHOT HOLE SPACING DEPENDS ON SOIL DENSITY & MOISTURE
CAST SOIL
SIDE VIEW
⊗ DELAYED FIRE
○ INSTANTANEOUS FIRE
FIGURE 4: CREATING A WILDLIFE ISLAND FROM A PENINSULA

Figure 4. **Creating an island for wildlife use safe from predator access.**

These pits are not intended to provide year-long water. If designed correctly, they should dry up about the time proper utilization of forage is achieved.

Several factors determine the success of using explosives to create pits capable of holding water for livestock and wildlife. Some of these are explained below by category.

Location

New sites should be selected to avoid hazards such as outbuildings, powerlines, underground telephone, oil, gas or water lines. Sites are in selected drainage-ways and aligned with the existing water course. See Figure 3.

Size

Size of pits is variable but is usually dictated by desired grazing time. It should be noted that the actual construction expense is from equipment, transportation of personnel and equipment, and not only from amount of explosive used.

Holes

When this effort was first started, a pickup-mounted Giddings* soil probe was used. Then a post hole auger mounted on a John Deere 310* backhoe was used. The holes were dug to the required depth by a 9-inch by 4-foot continuous flight auger with a locally made 2-foot bar stock extension. These holes could be dug with a post hole auger mounted on a tractor with a three-point hitch. The method used now is a Mobile* drill truck with a 9-inch auger, Figure 5. This has resulted in deeper holes, so pits are deeper.

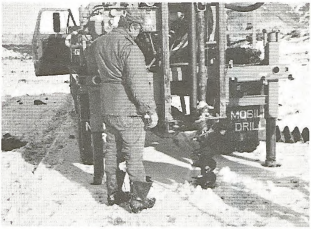


Figure 5. **The presently used method of drilling blasting holes is a truck-mounted drilling rig.**

The arrangement of the holes should be consistent and parallel with the centerline of the natural drainage, Figure 3.

Spacing of the holes varies from a minimum of 10 feet to a 12-15 foot maximum. This distance is a function of soil density, soil moisture, soil texture and experience. All holes should be equidistant to each other in the row and have staggered placement to the adjacent row, Figure 3.

Moisture content of the soil should be such that a soil sample can be molded easily by finger pressure and it can retain that shape when dropped on a hard surface. The fingers and hand should become moist but not wet from the soil. Soil that is too moist can cause problems such as that shown in Figure 6.

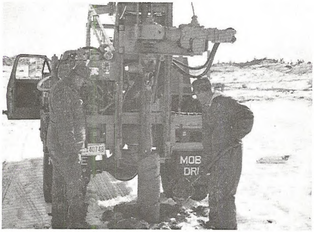


Figure 6. Water-saturated soil causes the drill bit to load up with silt.

Soil too dry results in loosened soil but not desired displacement; soil that is too wet results in equipment problems and misfires of explosive or primers due to water. In summary, holes should be a minimum of 6 feet deep and 9 inches wide; damp, without free water; free of clods and debris; have smooth walls without sloughing and be located according to the appropriate pattern along the natural drainage.

Firing Systems

In general, there are two systems for firing explosives; electric and nonelectric. As a rule, electric firing systems are safer, especially when used near roads, livestock, etc., by providing control of detonation time. The knowledge and equipment required to use electric caps makes the safety fuse probably the easiest and safest. A disadvantage of nonelectrical caps is once the fuse it lit, control of the shot is lost.

For safety reasons, a known length of solidly-packed fuse is cut off, lit, and its burning time is determined. (A number of factors, such as air temperature and humidity, age of fuse, storage conditions, etc., determine the burning time.) This should be done before each shot. After this test burn is made, the needed length (time) of fuse is cut, the cap is crimped on the fuse, Figure 7, and it is taped to the trunk line. The following is a list of materials needed to accomplish pit excavation:

Figure 7. A blasting cap is crimped to the end of the detonating fuse.

- — Hole drilling equipment
- — Ammonium Nitrate-Fuel Oil (ANFO)
- — Primers — cast boosters and power primers
- — Det cord (various sizes) for downline and trunk line
- — Delayed detonators
- — Standard crimping pliers
- — Pocket knife
- — Electrical tape (taping primer to det cord)
- — Duct tape
- — Blasting caps

For electrical firing systems

- — 1500 feet of 14-gauge duplex lead wire
- — Wire reel to hold the wire while not in use
- — Galvanometer
- — Blasting machine

Primers

We have used two types of primers on these projects. The 2-inch x 8-inch Atlas* power primer and the 16-ounce cast booster by Trojan*, Figure 8. The Atlas primer is placed in the outside holes and is exploded instantaneously by using Ensign Bickford E-cord* (25 grain) for downline. The centerline holes are different in that the downline is 18 grain Deta-cord*, hooked to a Nonel Primadet HD MS 2* (50 msec delay) primer. This in turn is placed in the cap well of the cast booster. The reason for selecting the bottom position for time delays was to minimize the risk of cutting off the downline or trunk line due to ground movement during the blast.

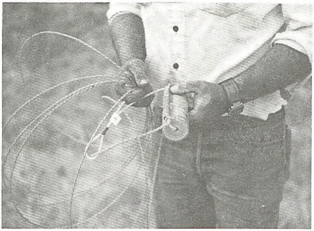


Figure 8. A properly connected 16-ounce cast booster is illustrated.

Loading Techniques

After the holes were plotted and drilled, they were checked and cleaned if needed. A decision was made for either "wet" or "dry" loading as ANFO will not detonate when wet. Plastic-lined (waterproof) cartridges 8-inch x 50 pounds were used. (See Figure 9.) These cartridges have the benefit of easy handling and provide a known weight of charge. If the holes were "dry", the ANFO bags were cut and up to ¼ of the total charge was placed in the hole, Figure 10, with a primer in the center, (Figure 11) the remaining ANFO was poured in. The bags were then tamped in on the top of the charge, Figure 12.

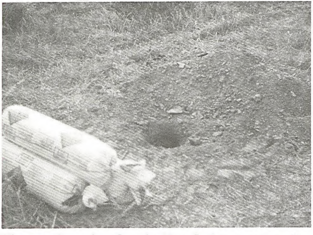


Figure 9. A plastic-lined (waterproof) cartridge of ammonium nitrate fuel oil (ANFO) is the basic charge selected for use in blasting water pits.

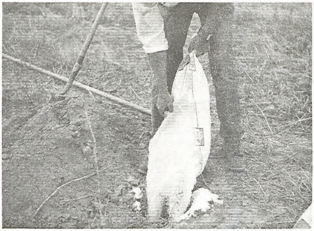


Figure 10. The ANFO cartridge was cut and up to one-fourth of the charge was dumped in the hole.

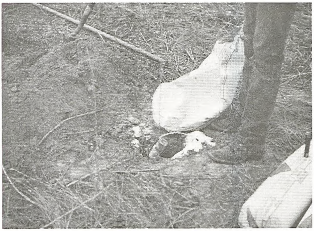


Figure 11. The primer was placed in the hole after some ANFO was poured in and before the last charge was added.

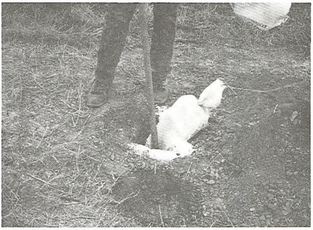


Figure 12. The bags containing the charges were tamped in the hole atop the charges.

If the holes were very moist or had free water, the cartridges were not cut open. They were used as packed and the power primer or cast primer, depending on the row, was duct taped to the bottom and lowered down the hole with a rope. Care was taken when loading holes to avoid any soil falling between the cartridges, which could cause a misfire. The ANFO charges must be in contact with each other to ensure detonation. The amount of ANFO placed in the holes was as follows: The outside rows had 100 pounds per hole, and the inside row had 150 pounds per hole. The best depth for the center row is about 13 feet and the outside row should be 8 feet. We determined that additional ANFO was not needed and that deeper holes on the outside row(s) caused the sides to shear up instead of out at a slope of 2½ or 3 to 1. Additional problem(s) are: (1) The hole(s) fill with water, and care must be taken to make sure the cartridge doesn't float up; (2) sides fall in; (3) the primer falls off the cartridge, causing a misfire or improper shot hole placement.

Care must be exercised when using det-cord*, to not pinch it and avoid any sharp bends or kinks, which could cause a misfire. At this time, the holes may be backfilled with drill cuttings, using care not to hit the "downline" with shovels, which could cut it off. After this is done, the area is cleared of all equipment and unnecessary personnel. The "trunkline" is laid out and "downlines" attached at right angles, and the remainder of the line is placed in gentle curves, Figure 13. The cap or fuse is attached and personnel and site are cleared prior to ignition of fuse or detonation of cap.

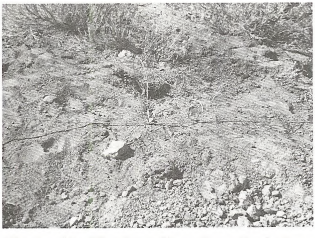


Figure 13. The downlines from the holes to the trunkline were attached at right angles.

After detonation, the blaster in charge will check the area to determine if all charges detonated. Closer inspection will be done by him, making sure the area has cleared. Headaches from ammonia and nitrogen can occur if personnel go into the area too soon. Problems, their reasons and countermeasures are explained in Figure 14.

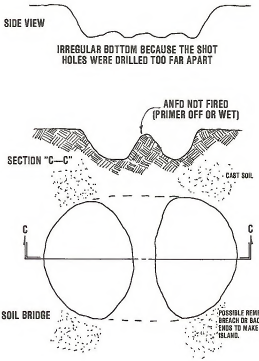

SIDE VIEW
IRREGULAR BOTTOM BECAUSE THE SHOT HOLES WERE DRILLED TOO FAR APART
ANFO NOT FIRED (PRIMER OFF OR WET)
SECTION "C—C"
CAST SOIL
C
C
SOIL BRIDGE
POSSIBLE REMEDY. BREACH OR BACKHOE ENDS TO MAKE GOOSE ISLAND.

Figure 14. Some possible problems that could result from improper hole spacing or misfires and a possible remedy.

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*Use of product name does not imply endorsement of that product.

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